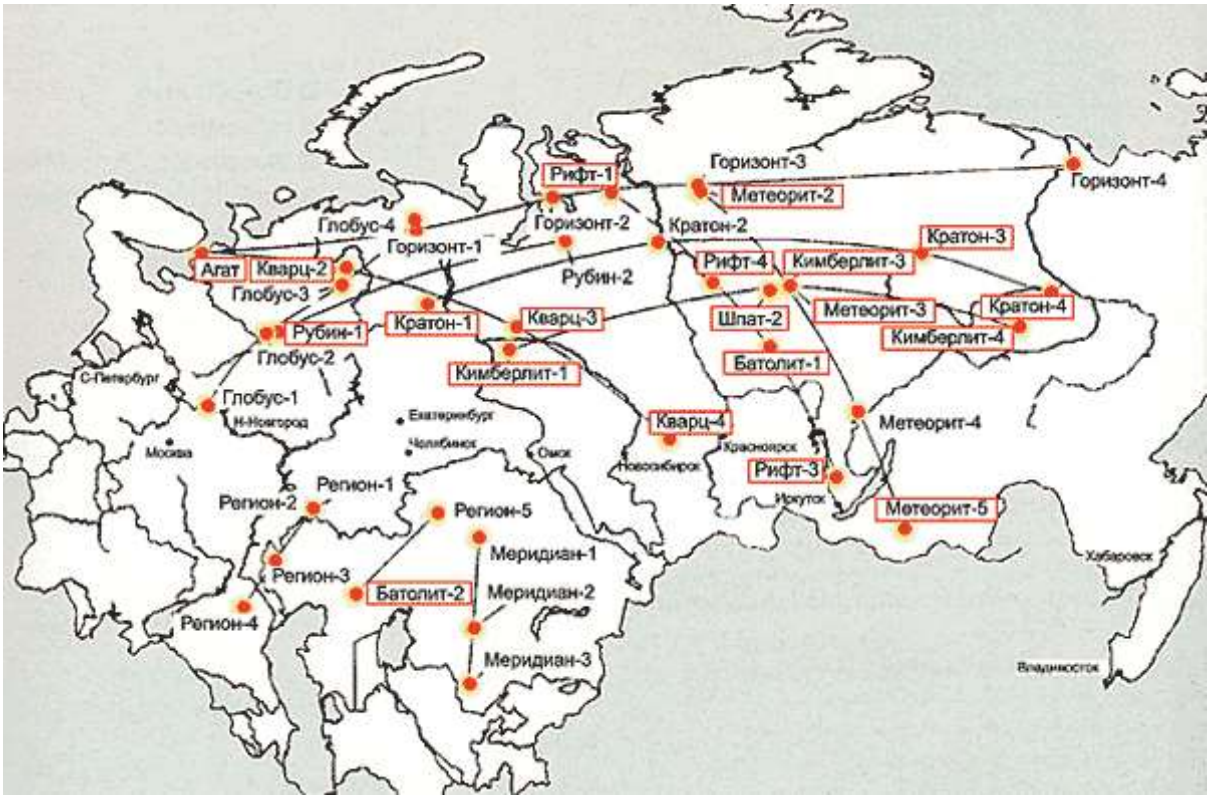
Peaceful explosions

RFNC-VNIITF took an active, and in some areas decisive, part in the development and implementation of the Soviet state program No. 7 "Nuclear explosions for the national economy". Of the 124 peaceful explosions conducted in the USSR, 80 nuclear charges developed at VNIITF were used in 75 cases.

Industrial explosions of nuclear charges at VNIIEF were pioneering in 1965-67. VNIIEF began to conduct peaceful explosions of its charges in May 1968. But VNIIEF began to develop peaceful nuclear explosive devices (NED) with specific characteristics corresponding to application conditions that are fundamentally different from the operating conditions of defense products in 1966. In the process of developing such NED, it was necessary to conduct preliminary tests of them at the test site. VNIIEF had twenty such experiments with new NED. Sometimes it was possible to combine the development of a new design with the industrial use of the corresponding device.



All developments of nuclear explosive devices for peaceful purposes were headed, implemented, supported and supervised at VNIITF by academicians E.I. Zababakhin, E.N. Avrorin and B.V. Litvinov. The production and provision of applications of nuclear explosive devices were directly supervised by G.P. Lominsky, who worked as the director of VNIITF from 1964 to 1988, i.e. during the implementation of the peaceful explosions program. In total, 14 types of nuclear explosive devices were developed for industrial applications at the institute, nine of which had optimal operational characteristics and were actually used in conducting nuclear explosions for national economic purposes.

State Program No. 7 "Nuclear Explosions for the National Economy" was, naturally, a complex and comprehensive effort by numerous ordering departments, design organizations, and enterprises that ensured the development and use of nuclear explosive devices. Our institute closely and effectively interacted with the All-Russian Scientific Research Institute of Industrial Technology and the Design Bureau of Automobile Equipment of the Ministry of Medium Machine Building, as well as with a number of other Ministries of the former USSR.

Nuclear explosive devices of VNIITF were used in the following areas:

- deep seismic sounding of the earth's crust in order to search for structures promising for mineral exploration (22 explosions). Customer - USSR Ministry of Geology;
- creation of underground tanks (22 explosions). Customer - USSR Ministry of Gas Industry;
- intensification of oil and gas production (16 explosions). Customers - USSR Ministry of Oil Industry, USSR Ministry of Geology, USSR Ministry of Gas Industry;
- testing of nuclear explosive technologies (6 explosions). Customer - USSR Ministry of Medium Machine Building;
- shutting off gas fountain wells (4 explosions). Customer - USSR Ministry of Geology;
- ore crushing (2 explosions). Customer - USSR Ministry of Mineral Fertilizers;

- burial of biologically hazardous industrial wastewater from petrochemical production (2 explosions). Customer - USSR Ministry of Oil Refining and Petrochemical Industry;
- creation of a trench-excavation in alluvial soils (1 explosion). Customer - USSR Ministry of Land Reclamation and Water Management.

Most often, peaceful nuclear explosive devices were placed in deep wells of a fairly small diameter. This gave rise to requirements to minimize the diameter of the structure, ensure its tightness and heat resistance, and also control the automatic detonation and obtain information about the parameters of the nuclear explosive device operation.

Maximum requirements were imposed on the design of devices in cases of gas fountain suppression by squeezing the trunks of emergency wells at great depths. A striking example of such an accident was the Pamuk gas field in the Kashkadarya region of Uzbekistan. Here it was necessary to lay a nuclear explosive device at a depth (vertically) of 2440 m, deliver it to the design mark along the wellbore cased with a pipe with an internal diameter of 274 mm; the gas pressure in the formation was 585 kg/cm2 and the temperature of the rock in the area of the nuclear explosive device was +105ºC. The development of a nuclear charge for such a nuclear explosive device was started at VNIITF in May 1966 and was carried out with great enthusiasm of all its participants.

While there were no special requirements for the "purity" of charges for camouflage peaceful explosions, NEDs with a minimum amount of radioactive fission fragments were needed for explosions for ejection (formation of dams, trenches). In these cases, thermonuclear devices, in which the main energy release is due to fusion reactions, are more suitable. Such charges were also included in the series of peaceful NEDs developed at VNIITF and were used to create a trench on the Pechora-Kolvinsky Canal (Perm Region) - a component of the project developed in the 1970s to divert water from northern rivers to the Volga. The experiment to create this trench was called "Taiga". Its implementation was preceded by model explosions of low-yield (0.2 kt) nuclear charges in boreholes at the Semipalatinsk test site (1968) "Telkem-1" and "Telkem-2", where the

formation of an ejection funnel (single explosion, T-1) and a short trench (group explosion of three charges, T-2) was tested. Analysis of the results of these explosions was used in the design of the main experiment "Taiga". A year after this experiment, an improved "clean" charge with a 5-fold reduced fragmentation activity compared to that used in Operation Taiga was tested at the Semipalatinsk test site. However, in order to unconditionally comply with the provisions of the Moscow Treaty (1963), it was decided not to conduct explosions for ejection.

In October 1971, using the VNIITF nuclear explosive device, an experiment was conducted to create an underground tank for storing gas condensate at the Dedurovsky gas condensate field. A specially designed small-caliber device was detonated in a salt formation at a depth of 1,140 m. As a result, the necessary tank was formed, which solved the problem of collecting and storing valuable chemical raw materials with subsequent processing.

The experience of previous work made it possible to create underground storage tanks for biologically harmful waste from the Sterlitamak soda-cement and Salavat petrochemical plants at a depth of 2000 m in 1973 and 1974.

Among all peaceful applications of nuclear explosive technologies, perhaps the most striking in terms of the project design were two pilot industrial underground explosions of full camouflage, conducted in 1972 and 1984 in the Kuelporr mountain range near Kirovsk (Kola Peninsula) for the purpose of crushing apatite ore (the Dnepr project). In order to significantly reduce the radioactive contamination of the crushed rock, the Dnepr experiments used a so-called "clean" nuclear charge and a system of directed removal and burial of active explosion products in the "empty" rock surrounding the ore body. The first experiment was conducted on September 4, 1972. The success of the first experiment made it possible to propose and implement the second one 12 years later, which was distinguished by the use of two nuclear charges of lower power (1.7 kt) for crushing a much larger block of ore. The experiment was conducted on August 27, 1984, in the same mountain range of Kuelporr. The outcome of the experiment was successful, the radiation situation in the test area was normal. The data of all measurement methods were obtained in full, the processing of their results confirmed the achievement of the objectives of the experimental industrial explosion.

In conclusion, we note that VNIITF is essentially the only organization in the world developing specialized nuclear explosive devices for industrial applications. Pilot-industrial explosions of such devices accounted for more than 60% of all peaceful nuclear explosions conducted in the USSR in 1965-1988; the share of VNIITF charges used in explosions to intensify oil and gas production exceeded 75%, and for the formation of underground tanks reached almost 90%. The geography of peaceful explosions conducted is shown in the figures.

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